

REMARKS

Claims 1, 4, 8-11 and 13-22 are pending in this application. Claims 1, 9 and 19 have been amended to recite the feature that was previously presented in claim 12, which is now cancelled. No new matter has been introduced by this change and no new issues are being raised since claim 12 was previously presented and examined. As applicants are now claiming a preferred embodiment that was previously recited in claim 12, this amendment should be entered to reduce the issues for appeal, preferably by placing the application in condition for allowance.

Before addressing the rejections, a brief review of the present invention may be helpful. In the preferred embodiment of the invention, a weakened zone is created in a wafer to define the layer to be detached and a remainder portion of the wafer, wherein the weakened zone includes a main region and a localized super-weakened region that is more weakened than the main region. The super-weakened region is created by implanting an overdose of the atomic species compared to the dose of atomic species implanted in the main region.

The creation of an implantation overdose in a predetermined region of the wafer is one where that region of the wafer receives a greater dose of atomic species than the remainder of the wafer. This local implantation overdose may be obtained by first implanting the wafer in a spatially homogeneous manner, and locally implanting an overdose into a desired region.

Alternatively, the species beam of an implanter can be displaced over the wafer surface, so as to sweep the surface of this wafer in a preselected manner, such that the kinematics of beam displacement over the wafer surface performs a spatially homogeneous implantation on the wafer surface, except for the desired specific region into which the overdose is implanted. The implanter emitting the species beam, for instance, can be immobilized for a time sufficient to create the overdose. In this configuration, the wafer can be fixed while the implanter beam is displaced. It is likewise possible to displace the wafer in a controlled manner, facing a fixed beam to achieve an implantation of the atomic species with the same distribution.

The weakened zone can thus be created to compromise a region that has a locally greater concentration of implanted species. This super-weakened region of increased weakness of the weakened zone has a greater weakness of the bond between the layer to be detached and the remainder of the wafer's super-weakened region thus corresponds to a starting region for the detachment of the layer bonding the zone of weakness. It is most preferred that this super-weakened region is produced at or near the periphery of the wafer.

The step of making the weakened zone has thus been performed to create in this zone a localized region where the weakened zone has a greater weakness, locally, so that this region corresponds to a super-weakened region of the weakened zone.

This super-weakened region establishes a "starting region", the meaning of which will become apparent hereinafter. The starting region of the embrittlement zone is localized. The starting region may, for example, be a region that covers an angular sector on the order of several degrees at the periphery of the embrittlement zone. It is likewise possible, in an alternative embodiment, to constitute this specific region mostly or all around the periphery of the wafer. In this case, the angular sector covered by the starting region may be as much as 360°. The width of this region having a ring shape is thus small, substantially less than one centimeter.

Claims 1, 4, 8-12, and 14-22 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,597,039 to Ohmi et al. ("Ohmi") in view of U.S. Patent No. 6,162,705 to Henley et al. ("Henley"), while claim 13 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohmi in view of Henley and U.S. Patent Application No. 2003/0234075 to Aspar et al. ("Aspar"). Applicants traverse these rejections for at least the following reasons.

First of all, Applicants repeat and adopt herein the comments made in response to the previous office action. Applicants have established that Ohmi does not disclose heating the weakened zone by applying the heat substantially evenly over substantially the entire weakened zone, and wherein the heating is controlled for evening the heating applied to weakened zone such that the detachment initiates and propagates from the super-weakened region through the main region to detach the layer from the remainder portion, and the Office Action acknowledges this. Thus, Henley is cited as an alleged teaching that a thermal source can be used to apply heat in this manner. Applicants submit that this is an incorrect interpretation of Henley.

Henley does not disclose uniform heating because in his method of removing a thin film of material from a substrate, a "controlled cleaving action" is desired. This is achieved by the selective placement of pulses of energy at or near the edge of the target wafer, so that energy is supplied to a selected region of the substrate material to initiate a cleave front which self-propagates through the implanted region of the substrate until the thin film of material is removed. Henley simply cannot achieve this controlled cleaving action by the uniform application of heat to the entire substrate, since he would not be able to control the cleaving action in the manner described.

Furthermore, to the extent that Henley does utilize thermal sources to assist with the cleaving action, there is absolutely no mention of the heat being applied uniformly over the substrate material. Subjecting a wafer to an environment at a constant temperature, such as by placing a wafer in a furnace that provides a particular temperature, is not the same as applying heat substantially uniformly over a surface. To accomplish such uniform surface heating, the amount of heat provided needs to be varied at different locations with respect to the wafer, such as by selectively controlling the heating elements to apply different amounts to different portions of the substrate. There is no suggestion to do this in Henley.

Instead, to achieve the controlled cleaving action when subjecting the wafer to heating, Henley by necessity requires the existence of a temperature gradient within the substrate so that energy is provided in a localized way to selected portions of the wafer, e.g., the edge. Therefore, Henley teaches away from uniform heating so that the combination of Ohmi and Henley does not result in the invention defined by independent claims 1, 9 and 19.

Furthermore, these independent claims also recite that the super-weakened region is created by implanting an overdose of the atomic species compared to the dose of atomic species implanted in the main region. The office action suggests that Ohmi discloses this in col. 10, lines 13-17. As noted herein, what Ohmi does not disclose is the heating of the weakened zone by applying the heat substantially evenly over substantially the entire weakened zone, so that even if Ohmi discloses dual implanting, he does not meet the heating feature of the present claims. And as further noted herein, a skilled artisan is not taught by Henley to apply heating in the presently claimed manner since Henley is directed to a controlled cleaving process that requires a localized application of energy (i.e., a mechanical force or heating) to achieve that result. The present rejection appears to be based on a hindsight reconstruction of the prior art using selective but unrelated portions of the references in an attempt to replicate Applicants' invention. The reasoning for doing this appears to be the fact that Ohmi and Henley are from the same field of endeavor. Even so, this fact does not render the present claims obvious because even if the references are combined as suggested, they do not result in what is presently claimed. As Henley teaches away from uniform heating, there is no motivation to modify Ohmi to apply or control heat substantially evenly over substantially the entire weakened zone. As neither Ohmi nor Henley teach or fairly suggest all the features of the present claims, the rejection of claims 1, 4, 8-11, and 14-22 under 35 U.S.C. § 103(a) has been overcome and should be withdrawn.


Regarding claim 13, Aspar does not remedy the deficiencies of Ohmi and Henley for the reasons mentioned in Applicants' response to the prior office action. Thus, the rejection of that claim under 35 U.S.C. § 103(a) has also been overcome and should be withdrawn.

Accordingly, it is believed that the entire application is now in condition for allowance, early notice of which would be appreciated. In the event that the Examiner does not agree that all claims are now allowable, a personal or telephonic interview is respectfully requested to discuss any remaining issues in an effort to expedite the eventual allowance of this application.

Respectfully submitted,

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Date



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